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(54) Title: PROCESS FOR PRODUCING α,β-UNSATURATED NITRILE

(57) Abstract

A process for producing an α,β-unsaturated nitrile, the process comprising the step of: reacting (1) a hydrocarbon selected from an olefin selected from propylene and isobutylene, a paraffin selected from propane and butane, and tertiary butyl alcohol, (2) ammonia, and (3) an oxygen-containing gas, in a reactor at a high temperature in a gas phase over a fluidized bed, so as to prepare an α,β-unsaturated nitrile having the same number of carbon atoms as the hydrocarbon as a starting material, the reactor comprising a reactor vessel having therein, from a bottom of the reactor vessel, an oxygen-containing gas dispersing plate or pipe and a mixed gas dispersing pipe for dispersing a mixed gas of the hydrocarbon and the ammonia, a pressure loss in the oxygen-containing gas dispersing plate or pipe is controlled to the range of from 0.6 to 3.0 times a pressure loss in the fluidized bed.

DESCRIPTION

PROCESS FOR PRODUCING α,β-UNSATURATED NITRILE

Technical Field

The present invention relates to a process for

5   producing an α,β-unsaturated nitrile which comprises the

ammoxydation of propylene, isobutylene, tertiary butyl

alcohol, propane or butane to prepare an α,β-unsaturated

nitrile having the same number of carbon atoms as the olefin,

paraffin or tertiary alcohol used as a starting material in a

10   high yield.

More particularly, the present invention relates to a

process for producing an α,β-unsaturated nitrile using a

novel reactor for effecting the gas phase reaction of

ammonia, an oxygen-containing gas and an olefin, tertiary

15   butyl alcohol or paraffin over a fluidized bed to produce an

unsaturated nitrile such as acrylonitrile and

methacrylonitrile, wherein the reactor is arranged such that

the pressure loss in an orifice attached to the jetting

portions in an oxygen-containing gas dispersing plate or pipe

20   and the pressure loss in an orifice attached to jetting

portions in a pipe for dispersing a mixture of ammonia, and

an olefin, tertiary butyl alcohol or paraffin (hereinafter

referred to as "mixed gas") are controlled.

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Background Art

Ammoxydation has long been industrially practiced. Many improvements have been made for ammoxydation from the standpoint of catalyst. However, few proposals have been

5   made for the structure of an apparatus (sparger) for supplying and spraying the starting material. It is disclosed in U.S. Patent 4,801,731 (JP-A-2-258 (The term "JP-A" as used herein means an "unexamined published Japanese patent application")). All these proposals feature the

10   disposition of an oxygen gas exit orifice and a propylene/ammonia exit orifice opposed to each other.

British Patent 1,265,770 describes the provision of a sparger disposed in the form of a ring on the peripheral portion of the reactor. However, the object of this

15   arrangement is to prevent the accumulation of a catalyst on the peripheral portion of the reactor. No reference is made to reactivity.

Few proposals have been made for the structure of dispersing plate or dispersing pipe. In particular, the

20   pressure loss in a dispersing plate or dispersing pipe is disclosed in Daizo Kunii, <u>Fluidization Engineering</u>, Octave Levenspiel, John Wiley & Sons. Inc., page 87 (1969). In this reference, 0.1 times the pressure loss in a fluidized bed is recommended as the pressure loss required for fluidized gas

25   dispersing pipe or dispersing plate. However, it was found that if gases are supplied through two systems in an

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industrial scale apparatus having a column diameter of not less than 3 m, the distribution of the supplied gas concentration is localized under the foregoing conditions, resulting in the reduction of the yield of the objective

5 unsaturated nitrile.

Disclosure of the Invention

An object of the present invention is to provide a process for producing an α,β-unsaturated nitrile by an ammoxydation reaction, particularly by the supply of reaction

10 gases through two system, in which the conversion of the reaction is enhanced by focusing the local distribution of concentration of reaction gases in the reactor.

The above and other objects and effects of the present invention will be more apparent from the following

15 description.

The present invention relates to a process for producing an α,β-unsaturated nitrile, the process comprising the step of:

reacting a hydrocarbon selected from an olefin

20 selected from propylene and isobutylene, a paraffin selected from propane and butane, and tertiary butyl alcohol; ammonia; and an oxygen-containing gas, in a reactor at a high temperature in a gas phase over a fluidized bed, so as to prepare an α,β-unsaturated nitrile having the same number of

25 carbon atoms as the hydrocarbon as a starting material,

the reactor comprising a reactor vessel having

therein, from a bottom of said reactor vessel, an oxygen-

containing gas dispersing plate or pipe and a mixed gas

dispersing pipe for dispersing a mixed gas of the hydrocarbon

5   and said ammonia,

a pressure loss in the oxygen-containing gas

dispersing plate or pipe is controlled to the range of from

0.6 to 3.0 times a pressure loss in the fluidized bed.

Brief Description of Drawings

10   Fig. 1 shows a vertical sectional view of one

embodiment of a fluidized bed reactor used in the present

invention.

Fig. 2 illustrates a schematic view of an example of

the fluidized bed reaction used in the present invention.

15   Figs. 3(a), 3(b), 3(c), and 3(d) each shows an

example of a vertical sectional view of a nozzle used in the

present invention.

Best Mode for Practicing the Invention

The present inventors have made extensive studies of

20   apparatus and conditions for production of unsaturated

nitrile over a fluidized bed. As a result, a surprising fact

has been found that the static pressure difference between

the peripheral portion of the reactor and the central portion

of the reactor in a large scale industrial apparatus having a

25   column diameter of not less than 3 m can reach not less than

200 mm/H_2O in some cases. Furthermore, among various

conditions and structural factors such as dispersing pipe,
such a static pressure difference has been found to influence
the yield of the unsaturated nitrile. It has been thus found
that by eliminating the effect of static pressure difference,
5   the yield of the unsaturated nitrile can be improved.

Ammoxydation reaction applied to the present
invention has long been known. In this reaction; a
hydrocarbon selected from an olefin selected from propylene
and isobutylene, a paraffin selected from propane and butane,
10   and tertiary butyl alcohol; ammonia; and an oxygen-containing
gas are reacted at a high temperature in a gas phase in the
presence of a catalyst in a fluidized bed reactor to produce
a corresponding α,β-unsaturated nitrile.

The present invention relates to a process for
15   producing an α,β-unsaturated nitrile, comprising reacting a
hydrocarbon selected from an olefin selected from propylene
and isobutylene, a paraffin selected from propane and butane,
and tertiary butyl alcohol; ammonia; and an oxygen-containing
gas, in a reactor at a high temperature in a gas phase over a
20   fluidized bed, so as to prepare an α,β-unsaturated nitrile
having the same number of carbon atoms as the hydrocarbon as
a starting material

The reactor used in the present invention comprises a
reactor vessel having therein, from a bottom of the reactor
25   vessel, an oxygen-containing gas dispersing plate or pipe and
a mixed gas dispersing pipe for dispersing a mixed gas of

said hydrocarbon and said ammonia, and the pressure loss in

the oxygen-containing gas dispersing plate or pipe is

controlled to the range of from 0.6 to 3.0 times, preferably

from 1.0 to 3.0 times, the pressure loss in the fluidized

5   bed.

The pressure loss in the mixed gas dispersing pipe is

preferably controlled to the range of from 0.6 to 5.0 times,

more preferably from 1.0 to 5.0 times, the pressure loss in

said fluidized bed.

10   It is more preferred that the pressure loss in the

mixed gas dispersing pipe is greater than that of the oxygen-

containing gas dispersing plate or pipe.

In a preferred embodiment of the present invention,

the pressure loss in the oxygen-containing gas dispersing

15   pipe or plate and that of the mixed gas dispersing pipe can

be controlled to desired values by adjusting the opening area

of the orifice (orifice area) x (number of orifices).

Since the composition of gases to be supplied into

the fluidized bed reactor is a high temperature olefin,

20   paraffin or tertiary alcohol falling within its explosion

limit, the mixture of the olefin, paraffin or tertiary

alcohol and ammonia (hereinafter referred to as "mixed gas")

needs to be supplied separately from the oxygen-containing

gas.

An embodiment of the present invention will be described with reference to Figs. 1, 2 and 3, but the present invention is not construed as being limited thereto.

Fig. 1 is a vertical sectional view of a fluidized

5   bed reactor. Numeral 1 denotes a main body of the fluidized bed reactor (reactor vessel); 2 denotes a heat-removing coil; 3 denotes a "mixed olefin gas" dispersing pipe; and 4 denotes an oxygen-containing gas introducing pipe.

Fig. 2 illustrates an example of the positioning of

10   various nozzles featuring the present invention and a schematic view of circulation of catalyst particles. Numerals 5 denotes a nozzle in "mixed olefin gas" dispersing pipe which is generally disposed at the bottom of the reactor; 6 denotes a nozzle for the oxygen-containing gas; 7

15   denotes upward flow in the circulating flow of the fluidized bed catalyst particles; 8 denotes downward flow in the circulation of the catalyst particles; and 9 denotes the interface of the catalyst bed. Symbol B denotes the mixed gas and C denotes the oxygen-containing gas. It is known

20   that the catalyst density shows a sudden drop at a position above this interface. In the present invention, a "mixed olefin gas" dispersing pipe is disposed above the oxygen-containing gas dispersing plate or dispersing pipe.

Figs. 3(a), 3(b), 3(c), and 3(d) illustrate

25   embodiments of the nozzle for supplying a gas to be used in the present invention. Numeral 10 denotes an orifice portion

for adjusting the differential pressure, and 11 denotes a
shroud portion for jetting the gas. Symbol A denotes a gas
jetting direction.

 In the present invention, when the static pressure
5 difference between the peripheral portion of the reactor and
the central portion of the reactor was measured by using
upwardly open pressure taps, the peripheral portion of the
reactor showed 200 mm/H_2O higher than the central portion of
the reactor in some cases. When the static pressure
10 difference between the peripheral portion of the reactor and
the central portion of the reactor was measured using a
pressure tap which is downwardly open as similar to the mixed
gas dispersing pipe nozzle, the central portion of the
reactor showed a higher value than the peripheral portion of
15 the reactor, the difference therebetween being greater than
that obtained with upwardly open pressure taps. When the
static pressure difference between the peripheral portion of
the reactor and the central portion of the reactor is great,
the difference in the concentration of unreacted olefin
20 between the peripheral portion of the reactor and the central
portion of the reactor is great, reducing the yield.

 Thus, in the present invention, the pressure loss in
the oxygen-containing gas dispersing plate or pipe and, in a
preferred embodiment, the mixed gas dispersing pipe are each
25 adjusted to not less than 0.6 times, preferably not less than
equal to that in the fluidized bed. Since the static

pressure difference can be absolutely or relatively reduced

by controlling these pressure losses to the above range, the

conversion at the peripheral portion of the reactor is

remarkably enhanced as compared with the case where the

5   static pressure difference deviates from this range,

resulting in the enhancement of the conversion in the

reactor. The upper limit of the pressure loss in the oxygen-

containing gas dispersing plate or pipe can be determined

mainly by the economical efficiency of a gas compressor and

10   is generally not more than 3 times the pressure loss in the

fluidized bed. The upper limit of the pressure loss in the

mixed gas dispersing pipe can be determined by the operating

pressure of a chiller for olefin and ammonia from the

standpoint of process and is generally not more than 5 times

15   the pressure loss in the fluidized bed.

          In the present invention, it is preferred that the

opening area (orifice area) x (number of orifices) of the

oxygen-containing gas dispersing plate or pipe and that of

the mixed gas dispersing pipe are properly adjusted to keep

20   the pressure loss in these dispersing plates or pipes to the

foregoing ranges. For example, the opening ratio of the

orifice (opening area of orifice)/(sectional area of reactor)

of the oxygen-containing gas dispersing plate or pipe is

preferably controlled to the range of from 0.10 to 1.0%, more

25   preferably 0.12 to 0.35%, to realize the desired pressure

loss defined herein. The orifice opening ratio of the

orifice (opening area of orifice)/(sectional area of reactor) of the mixed gas dispersing pipe is preferably controlled to the range of from 0.01 to 0.2%, more preferably from 0.015 to 0.15%.

5   The pressure loss in the dispersing plates or pipes is generally proportional to the square of the gas flow rate and inversely proportional to the open area (orifice area) x (number of orifices). It also depends on the supplied amount of gas or the reactor pressure. Therefore, the pressure loss

10   may be properly controlled by changing the temperature or pressure conditions.

Even if the orifice opening ratio is constant, the pressure loss varies with the area of the shroud portion (gas jetting portion).

15   The more the (orifice area)/(shroud area) ratio is, the less is the pressure loss.

In the present invention, it is preferred that the ratio of a sectional opening area of the orifice portion to that of the shroud portion (sectional opening area of orifice

20   portion/sectional opening area of shroud portion) of the oxygen-containing gas dispersing plate or pipe and that of the mixed gas dispersing pipe is from 0.05 to 0.50, more preferably from 0.10 to 0.40.

In the present invention, the pressure loss in the

25   fluidized bed is the ratio of (the weight of catalyst)/(the sectional area of the reactor), which can be determined by

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the difference between the pressure developed at the
interface 9 of the catalyst bed in the reactor having a
fluidized catalyst and the pressure developed directly above
(0.1 m) the oxygen-containing gas dispersing plate or pipe.
5   The weight of the catalyst bed required for the fluidized bed
reactor can be properly determined by the activity of the
catalyst, the feed rate of the reaction materials and the
desired conversion.

In general, the amount of the catalyst is determined
10   such that the time during which the catalyst comes into
contact with the reactive gas is kept to about 1 to 20
seconds, preferably 2 to 12 seconds.

The pressure loss in the oxygen-containing gas
dispersing plate or dispersing pipe is the difference between
15   the pressure developed below the oxygen-containing gas
dispersing plate or inside the oxygen-containing gas
dispersing pipe and the pressure developed above the oxygen-
containing gas dispersing plate or outside the oxygen-
containing gas dispersing pipe. It is measured by means of a
20   pressure tap disposed below the oxygen-containing gas
dispersing plate or inside the oxygen-containing gas
dispersing pipe and above (0.05 m) the oxygen-containing gas
dispersing plate or dispersing pipe.

The pressure loss in the mixed gas dispersing pipe is
25   the difference between the pressure developed inside the
mixed gas dispersing pipe and the pressure developed outside

the mixed gas dispersing pipe. It is measured by means of a
pressure tap disposed inside the mixed gas dispersing pipe
and that disposed outside the mixed gas dispersing pipe.

Taking into account the fact that the required
5   pressure loss in the oxygen-containing gas dispersing plate
has been given as a requirement for the absence of fixed bed
in the reactor and the pressure loss in the mixed gas
dispersing pipe has not been considered important as the
required pressure loss in the oxygen-containing gas
10   dispersing plate, it is a very surprising fact that the
fulfillment of these requirements can provide remarkable
enhancement of the conversion at the peripheral portion of
the reactor and hence in the entire reactor in the present
invention.

15   While the diameter and constitution of the reactor
used in the present invention is not particularly limited,
the diameter of the reactor vessel is preferably 3 m or more
since in such an industrial scale apparatus, the localized
distribution of the supplied gas tends to be remarkable.

20   As the catalyst employable in the present invention,
any catalyst known as ammoxydation or oxidation catalyst,
e.g., molybdenum-bismuth-iron-supported catalyst, can be
used.

The reaction may be effected under known conditions
25   described in known references and patents. By way of
example, ammoxydation reaction for the production of

α,β-unsaturated nitrile may be effected under the following
conditions.

The amount of the oxygen-containing gas (such as air)
to be supplied into the reactor as a starting material is

5   generally from 5 to 15 mols, preferably from 7 to 14 mols,
per mol of the olefin, paraffin or tertiary alcohol. The
oxygen-containing gas is supplied into the reactor at the
bottom thereof in such a manner that the temperature thereof
is generally from 50 to 500°C, preferably from 100 to 400°C,

10 directly after supplied. The amount of ammonia to be
supplied is generally from 0.6 to 2 mols, preferably from 1
to 1.5 mols, per mol of the olefin, paraffin or tertiary
alcohol.

The reaction temperature is generally from 350°C to

15 600°C, preferably from 400°C to 500°C. The reaction pressure
is generally not more than 3 kg/cm^2-G, preferably from 0.2 to
1.5 kg/cm^2-G.

The olefin selected from propylene and isobutylene is
preferably used as the hydrocarbon as the starting material.

20   Example

The process of the present invention will be further
described in the following examples and comparative examples.

The pressure loss in the fluidized bed as used in the
following examples and comparative examples is the difference

25 between the pressure developed at the top of the reactor and

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the pressure developed at a pressure tap disposed 100 mm

above the dispersing plate.

The pressure loss in the oxygen-containing gas

dispersing plate is the difference between the pressure

5   developed below the oxygen-containing gas dispersing plate

and the pressure developed at the foregoing pressure tap.

The pressure loss in the mixed gas dispersing pipe is the

difference between the pressure developed inside the mixed

gas dispersing pipe and the pressure developed at the

10 foregoing pressure tap.

As a measure of the conversion, the concentration of

unreacted olefin at the central portion and peripheral

portion of the reactor was used.   For the measurement of the

concentration of unreacted olefin, a gas sampling nozzle was

15 disposed at a position in the central portion satisfying the

relationship $r/R = 0.0$ (wherein r is the distance from the

center of the reactor, and R is the reactor radius) at a

height of 9 m and at a position in the peripheral portion

satisfying the relationship $r/R = 0.9$ at the same height.

20 The gas discharged from these sampling nozzles were washed

with water, and then analyzed by gas chromatography. As the

instruments and other attachments there may be used commonly

used facilities having ordinary tolerance.

<u>EXAMPLE 1</u>

25 The reactor used had a diameter of 7.8 m. The

catalyst used was a molybdenum-bismuth-iron-supported

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catalyst having a particle diameter of from 10 to 100 μm and
an average particle diameter of 50 μm. The reactor was
filled with the catalyst in such an arrangement that the
height of the static bed reached 2 m. As an air dispersing
5   plate there was used a dispersing plate having an aperture
diameter of 16.5 mm, a ratio (sectional opening area of
orifice portion)/(sectional opening area of shroud portion)
of 0.35, and 560 orifices. For the mixture of propylene and
ammonia, a sparger having 560 nozzles attached to orifices
10   with an aperture diameter of 6.2 mm was used. Air was
supplied into the reactor at the bottom of the fluidized bed
at a rate of 41,000 Nm^3/H and a temperature of 250°C, and
propylene and ammonia were supplied at a rate of 4,000 Nm^3/H
and 4,800 Nm^3/H, respectively, and a temperature of 150°C.
15   The reaction was effected at a temperature of 450°C under a
pressure of 1 kg/cm^2-G. During this procedure, the pressure
loss in the air dispersing plate was 1,300 mm/H_2O. The
pressure loss in the propylene/ammonia sparger was 2,100
mm/H_2O. The pressure loss in the fluidized bed was 2,100
20   mm/H_2O. The results set forth in Table 1 were obtained.

TABLE 1

	Unreacted propylene (vol%)
Central portion	0.12
Peripheral portion	0.22

EXAMPLE 2

The reaction was effected in the same reactor as used in Example 1 under the same conditions as used in Example 1 except that a dispersing plate having 560 orifices with an aperture diameter of 14.0 mm was used as the air dispersing plate, a sparger having 560 nozzles attached to orifices with an aperture diameter of 4.7 mm was used for the mixture of propylene and ammonia, and the temperature of air to be supplied was 380°C. During this procedure, the pressure loss in the air dispersing plate was 2,100 mm/H_2O. The pressure loss in the propylene/ammonia sparger was 4,400 mm/H_2O. The pressure loss in the fluidized bed was 2,100 mm/H_2O. The results set forth in Table 2 were obtained.

TABLE 2

	Unreacted propylene (vol%)
Central portion	0.11
Peripheral portion	0.18

EXAMPLE 3

The reaction was effected in the same reactor as used in Example 1 under the same conditions as used in Example 1 except that a sparger having the same orifice aperture

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diameter as used in Example 1 but having an air jetting

portion (shroud portion) aperture diameter 0.8 times greater

than Example 1 (the ratio (sectional opening area of orifice

portion)/(sectional opening area of shroud portion): 0.55)

5   was used as the sparger as air dispersing plate. During this

procedure, the pressure loss in the air dispersing plate was

1,100 mm/H_2O. The pressure loss in the mixed gas dispersing

pipe was 2,100 mm/H_2O. The pressure loss in the fluidized

bed was 2,100 mm/H_2O. The results set forth in Table 3 were

10   obtained.

TABLE 3

	Unreacted propylene (vol%)
Central portion	0.11
Peripheral portion	0.28

15

EXAMPLE 4

The reaction was effected in the same reactor as used

in Example 1 under the same conditions as used in Example 1

except that a dispersing plate having 560 orifices with an

20   aperture diameter of 14.0 mm was used as the air dispersing

plate and a sparger having 560 nozzles attached to orifices

with an aperture diameter of 4.7 mm was used for the mixture

of propylene and ammonia. During this procedure, the

pressure loss in the air dispersing plate was 2,400 mm/H_2O.

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The pressure loss in the propylene/ammonia sparger was 4,400

mm/H_2O. The pressure loss in the fluidized bed was 2,100

mm/H_2O. The results set forth in Table 4 was obtained.

TABLE 4

5

	Unreacted propylene (vol%)
Central portion	0.06
Peripheral portion	0.10

COMPARATIVE EXAMPLE 1

10   The reaction was effected in the same reactor as used

in Example 1 under the same conditions as used in Example 1

except that a dispersing plate having 560 nozzles attached to

orifices with an aperture diameter of 20 mm was used as the

air dispersing plate and a sparger having 560 nozzles

15   attached to orifices with an aperture diameter of 13 mm was

used for the mixture of propylene and ammonia. During this

procedure, the pressure loss in the air dispersing plate was

600 mm/H_2O. The pressure loss in the propylene/ammonia

sparger was 790 mm/H_2O. The pressure loss in the fluidized

20   bed was 2,100 mm/H_2O. The results set forth in Table 5 were

obtained.

TABLE 5

	Unreacted propylene (vol%)
Central portion	0.15
Peripheral portion	0.40

In the present invention, the pressure loss in
oxygen-containing gas and mixed olefin gas in the fluidized
bed reactor in ammoxydation reaction is controlled to provide
remarkable improvements in the fluidity of the fluidized bed.
Thus, the concentration of unreacted olefin at the peripheral
portion of the reaction is lowered. Further, the difference
in the concentration of unreacted olefin between the
peripheral portion of the reactor and the central portion of
the reactor is reduced. Accordingly, the conversion at the
peripheral portion of the reactor is remarkably enhanced.
Thus, the enhancement of the yield of unsaturated nitrile can
be realized.

CLAIMS

1.   A process for producing an α,β-unsaturated
nitrile, said process comprising the step of:
    reacting (1) a hydrocarbon selected from an olefin
5   selected from propylene and isobutylene, a paraffin selected
from propane and butane, and tertiary butyl alcohol, (2)
ammonia, and (3) an oxygen-containing gas, in a reactor at a
high temperature in a gas phase over a fluidized bed, so as
to prepare an α,β-unsaturated nitrile having the same number
10   of carbon atoms as said hydrocarbon as a starting material,
    said reactor comprising a reactor vessel having
therein, from a bottom of said reactor vessel, an oxygen-
containing gas dispersing plate or pipe and a mixed gas
dispersing pipe for dispersing a mixed gas of said
15   hydrocarbon and said ammonia,
    a pressure loss in said oxygen-containing gas
dispersing plate or pipe is controlled to the range of from
0.6 to 3.0 times a pressure loss in said fluidized bed.

2.   A process as claimed in claim 1, wherein a
20   pressure loss in said mixed gas dispersing pipe is controlled
to the range of from 0.6 to 5.0 times a pressure loss in said
fluidized bed.

3.   A process as claimed in claim 1, wherein said
pressure loss in said oxygen-containing gas dispersing plate
or pipe is controlled to the range of from 1.0 to 3.0 times a
pressure loss in said fluidized bed.

5   4.   A process as claimed in claim 2, wherein said
pressure loss in said mixed gas dispersing pipe is controlled
to the range of from 1.0 to 5.0 times a pressure loss in said
fluidized bed.

5.   A process as claimed in claim 1, wherein said
10   oxygen-containing gas dispersing plate or pipe has a
differential pressure adjusting orifice having an opening
ratio (opening area of orifice)/(sectional area of reactor)
of from 0.10 to 1.0%.

6.   A process as claimed in claim 5, wherein said
15   oxygen-containing gas dispersing plate or pipe has a
differential pressure adjusting orifice having an opening
ratio (opening area of orifice)/(sectional area of reactor)
of from 0.12 to 0.35%.

7.   A process as claimed in claim 2, wherein said
20   mixed gas dispersing pipe has a differential pressure
adjusting orifice having an opening ratio (opening area of
orifice)/(sectional area of reactor) of from 0.01 to 0.2%.

CLAIMS

    1. A process for producing an α,β-unsaturated nitrile, said process comprising the step of:

    reacting (1) a hydrocarbon selected from an olefin

5   selected from propylene and isobutylene, a paraffin selected from propane and butane, and tertiary butyl alcohol, (2) ammonia, and (3) an oxygen-containing gas, in a reactor at a high temperature in a gas phase over a fluidized bed, so as to prepare an α,β-unsaturated nitrile having the same number

10   of carbon atoms as said hydrocarbon as a starting material,

    said reactor comprising a reactor vessel having therein, from a bottom of said reactor vessel, an oxygen-containing gas dispersing plate or pipe and a mixed gas dispersing pipe for dispersing a mixed gas of said

15   hydrocarbon and said ammonia,

    a pressure loss in said oxygen-containing gas dispersing plate or pipe is controlled to the range of from 0.6 to 3.0 times a pressure loss in said fluidized bed.

    2. A process as claimed in claim 1, wherein a

20   pressure loss in said mixed gas dispersing pipe is controlled to the range of from 0.6 to 5.0 times a pressure loss in said fluidized bed.

3.   A process as claimed in claim 1, wherein said pressure loss in said oxygen-containing gas dispersing plate or pipe is controlled to the range of from 1.0 to 3.0 times a pressure loss in said fluidized bed.

5   4.   A process as claimed in claim 2, wherein said pressure loss in said mixed gas dispersing pipe is controlled to the range of from 1.0 to 5.0 times a pressure loss in said fluidized bed.

5.   A process as claimed in claim 1, wherein said
10   oxygen-containing gas dispersing plate or pipe has a differential pressure adjusting orifice having an opening ratio (opening area of orifice)/(sectional area of reactor) of from 0.10 to 1.0%.

6.   A process as claimed in claim 5, wherein said
15   oxygen-containing gas dispersing plate or pipe has a differential pressure adjusting orifice having an opening ratio (opening area of orifice)/(sectional area of reactor) of from 0.12 to 0.35%.

7.   A process as claimed in claim 2, wherein said
20   mixed gas dispersing pipe has a differential pressure adjusting orifice having an opening ratio (opening area of orifice)/(sectional area of reactor) of from 0.01 to 0.2%.

8.   A process as claimed in claim 7, wherein said mixed gas dispersing pipe has a differential pressure adjusting orifice having an opening ratio (opening area of orifice)/(sectional area of reactor) of from 0.015 to 0.15%.

5   9.   A process as claimed in claim 1 or 2, wherein said pressure loss in said mixed gas dispersing pipe is greater than that of said oxygen-containing gas dispersing plate or pipe.

10.   A process as claimed in claim 3 or 4, wherein
10   said pressure loss in said mixed gas dispersing pipe is greater than that of said oxygen-containing gas dispersing plate or pipe.

11.   A process as claimed in claim 1 or 3, wherein a feeding temperature of said oxygen-containing gas is
15   controlled to 50 to 500°C, so as to control said pressure loss in said oxygen-containing gas dispersing plate or pipe.

12.   A process as claimed in claim 1 or 3, wherein said oxygen-containing gas dispersing plate or pipe has a nozzle comprising an orifice portion for adjusting a
20   differential pressure and a shroud portion for jetting said oxygen-containing gas, and a ratio of a sectional opening area of said orifice portion to that of said shroud portion

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(sectional opening area of orifice portion/sectional opening
area of shroud portion) is from 0.05 to 0.50.

13.   A process as claimed in claim 2 or 4, wherein
said mixed gas dispersing pipe has a nozzle comprising an
5   orifice portion for adjusting a differential pressure and a
shroud portion for jetting said mixed gas, and a ratio of a
sectional opening area of said orifice portion to that of
said shroud portion (sectional opening area of orifice
portion/sectional opening area of shroud portion) is from
10   0.05 to 0.50.

14.   A process as claimed in claim 1 or 2, wherein
said hydrocarbon is an olefin selected from propylene and
isobutylene.

Fig. 1
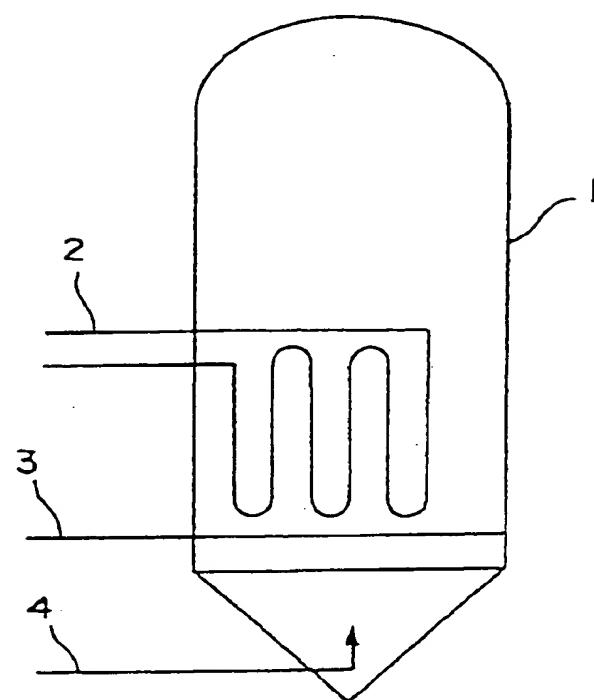
Fig. 2
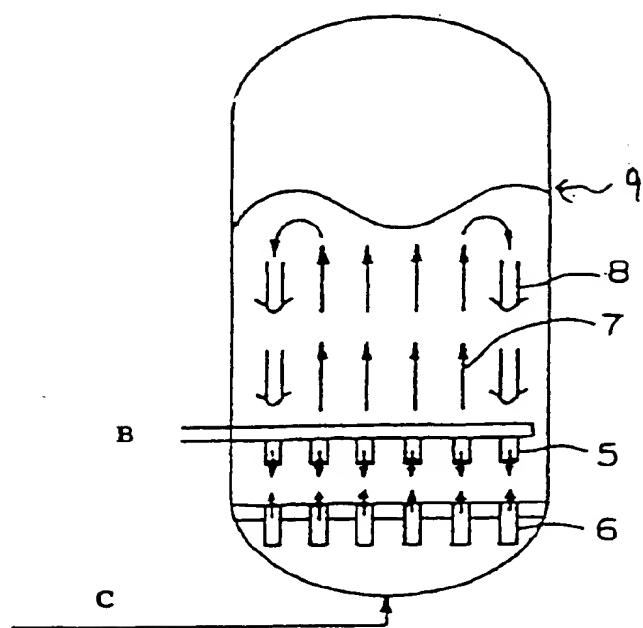
Fig. 3(a)
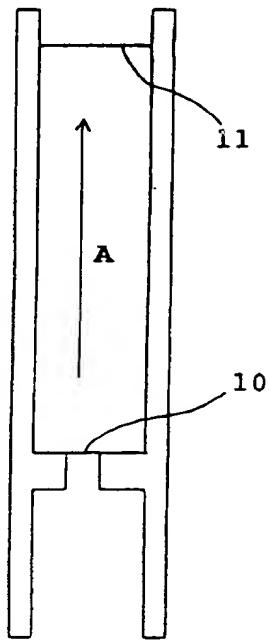
Fig. 3(b)
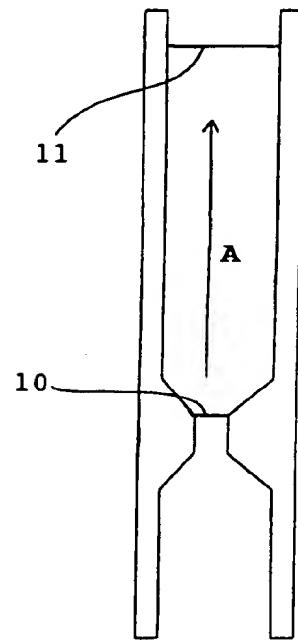
Fig. 3(c)
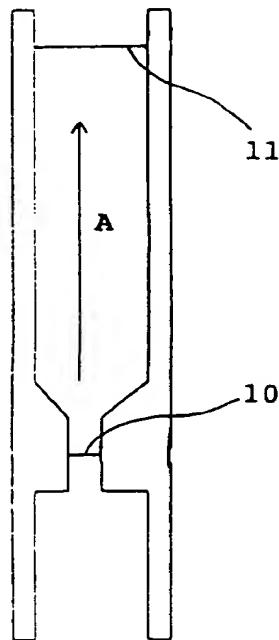
Fig. 3(d)
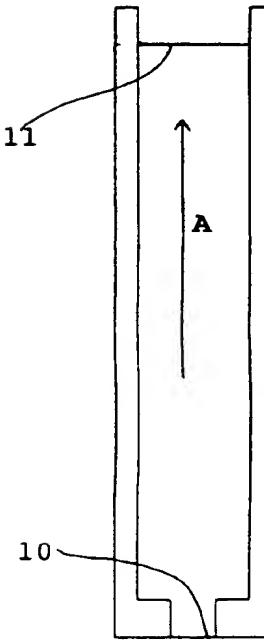
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6   C07C253/24   C07C253/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6   C07C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 446 379 (ASHAI KASEI KOGYO KABUSHIKI KAISHA) 18 September 1991 see whole document	1-14
A	US,A,5 256 810 (ROWE ET. AL.) 26 October 1993 see whole document	1-14
A	US,A,4 801 731 (JORDAN) 31 January 1989 cited in the application see whole document	1-14
A	GB,A,1 265 770 (MONSANTO) 8 March 1972 see whole document	1-14

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 July 1996	*I.M.Helps* 15. 07. 96

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